Original Article

The study of the impact of digital technologies on the health and psychological state of children

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ABSTRACT

The article presents the results of a comprehensive study of the psychological and psychosomatic health of modern schoolchildren in the context of the digital transformation of society. The study was conducted on a representative sample of 880 students aged 10 to 16 from the cities of Nalchik, Vladikavkaz, and Stavropol. The relevance of the study is due to the growing problem of the impact of digital technologies on children's health. In the course of the work, significant deviations in the psychological state of schoolchildren were identified: increased anxiety was observed in 42% of the surveyed, attention disorders affected 37% of students, and indicators of autonomic dysfunction were detected in 45% of the study participants. The research methodology combined psychological and pedagogical diagnostics with medical examinations, including assessment of physiological parameters, laboratory tests, and hormonal background analysis. A direct correlation has been established between the time spent using digital devices and the deterioration of health indicators. The results showed that if you exceed 4 hours of screen time per day, blood pressure levels significantly worsen, concentration decreases, and stress hormones increase. A high prevalence of social adjustment disorders was revealed, affecting 45% of the surveyed schoolchildren. The practical significance of the work lies in the possibility of using the data obtained to develop preventive programs and recommendations for the rational use of digital technologies in the educational environment.

Keywords: Screen time, Social adaptation, Psychosomatic disorders, Digital addiction, Children

Introduction

In the modern world, the problem of children's psychological health is becoming particularly relevant and important. Globalization and the rapid development of information technology are fundamentally changing the conditions of growing up of a new generation [1]. Children of the 21st century grow up in a unique environment where virtual space becomes an integral part of their daily lives [2-5]. The digital transformation of society has a complex impact on the formation of the child's psyche [6, 7]. From the very first years of life, modern children are confronted with various gadgets, which significantly change their perception of the world around them. According to research, about 70% of children aged 3-5 years are already actively using tablets and smartphones, and by the age of 10, almost every child has their mobile phone [8, 9].

Social networks play a special role in shaping the psychological state of modern children [10]. According to statistics, more than 85% of teenagers aged 13-17 regularly use social platforms [11].

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In Russia, this figure is about 78%, while a significant part of users begin to actively maintain social profiles from the age of 10-12 [12-15]. Information overload is becoming one of the key risk factors for the child's psyche. Modern children face a huge flow of information daily, which significantly exceeds their age-related processing capabilities [16-18]. Studies show that the average time children spend in front of the screen is 4-6 hours a day, which significantly exceeds the recommended standards [19, 20].

Academic pressure in modern education is constantly increasing. According to PISA international studies, the stress level of schoolchildren increases by 15-20% every 5 years [21]. In Russia, this trend can also be traced, especially in large cities, where competition in educational institutions is much higher [22, 23].

Social comparison through social media creates additional psychological problems. Studies show that 42% of teenagers experience anxiety due to comparing themselves with others on social media [24]. In Russia, this indicator is slightly lower (38%), but the upward trend continues [25].

Cyberbullying is becoming more common [26, 27]. According to international studies, about 30% of children have experienced online bullying at least once [28-31]. In Russia, this figure is 25%, while only 15% of victims seek help from adults.

Sleep problems in modern children are closely related to the use of gadgets. Studies show that more than 60% of teenagers regularly use smartphones before going to bed, which leads to sleep disorders and a decrease in the quality of rest [32, 33]. In Russia, this problem affects about 55% of schoolchildren.

A decrease in physical activity also negatively affects the psychological health of children. According to WHO, only 20% of children aged 5-17 years receive sufficient physical activity [34]. In Russia, this figure is about 25%, which is significantly lower than the recommended standards [35, 36].

Emotional burnout in children is becoming more common. According to research, about 15% of schoolchildren regularly experience symptoms of emotional exhaustion, and 25% periodically experience similar conditions [37-40].

Of particular concern is the increase in mental disorders among children and adolescents. According to WHO, over the past 10 years, the number of diagnosed cases of anxiety disorders has increased by 40%, and depressive states by 30% [41-44]. There is a similar trend in Russia, with a significant proportion of cases remaining undiagnosed.

Thus, modern childhood takes place under conditions of unprecedented exposure to various risk factors for psychological health **(Figure 1)**. The need for a comprehensive study of these factors and the development of effective preventive measures makes this study particularly relevant and significant for modern pediatrics and child psychology.

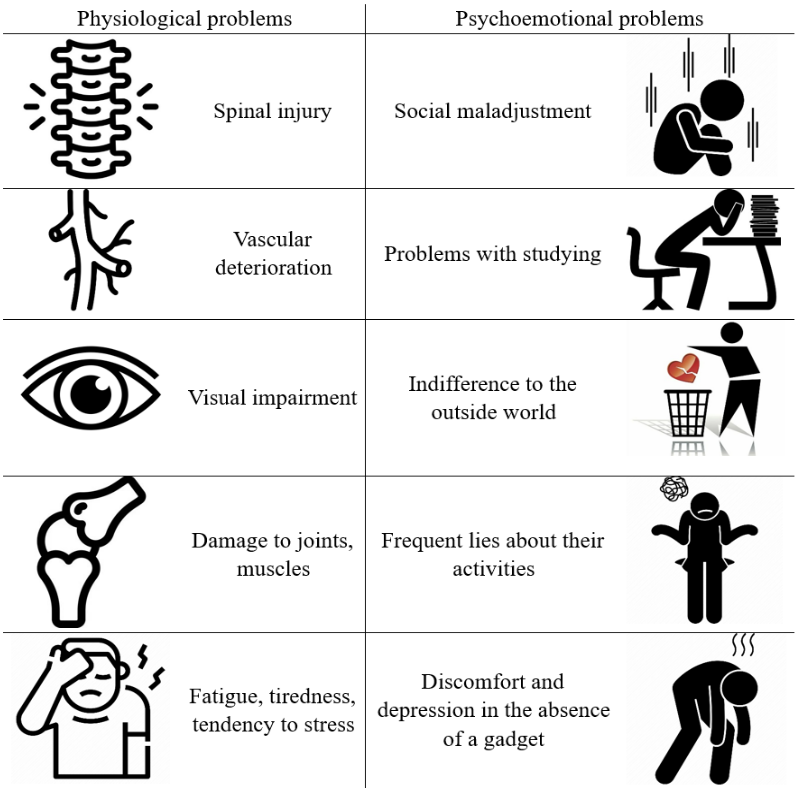

Figure 1. Factors influencing digital technologies on a child's psychophysical state

Understanding the mechanisms of the influence of modern factors on the child's psyche requires an interdisciplinary approach and combining the efforts of specialists from various fields: psychologists, educators, physicians, and sociologists [45-49]. Only this approach will make it possible to develop effective strategies to support children's psychological health in a rapidly changing world.

Materials and Methods

The study was conducted on a representative sample of 880 schoolchildren from the cities of Nalchik, Vladikavkaz, and Stavropol. The participants were secondary school students aged 10 to 16, with an average age of 13.2 years. The distribution of participants by age group was uniform, which ensured the reliability of the results obtained.

The research methodology was complex and combined psychological and pedagogical diagnostics with medical examinations. As part of the psychological and pedagogical diagnostics, standardized tests were used to determine the level of anxiety on the Spielberger scale, methods for assessing attention and memory, including a correction test and Schulte tables [50-52]. Special attention was paid to the diagnosis of emotional state using the Lusher color test, as well as the assessment of social well-being using sociometry [53, 54].

The medical examination included a comprehensive clinical examination with an assessment of the participants' physical development. Blood pressure and heart rate were measured both at rest and after standard physical activity. The parameters of the autonomic nervous system were studied, and laboratory tests were performed, including general and biochemical blood tests to determine stress markers [55]. The examination program included electrocardiography at rest and after exercise, as well as an assessment of sleep quality based on questionnaires and analysis of subjective indicators.

Data collection methods were based on an integrated approach. A questionnaire survey of students and their parents allowed us to collect information about the mode of the day, the time of using digital devices, preferences in social networks, a subjective assessment of the psychological state, and the nature of the educational load. In parallel, the educational process was observed in natural conditions, where behavioral reactions, concentration level, emotional state, and features of social interaction were recorded.

Statistical processing of the obtained data was carried out using modern methods of mathematical statistics. Methods of descriptive statistics, correlation, and variance analysis, as well as comparative analysis, were used to identify the relationships between various indicators.

The study was conducted in several successive stages. At the preparatory stage, a research program was developed, the necessary methods were selected and adapted, permits were obtained from educational institutions, and the research group was instructed. The main stage included direct psychological and pedagogical diagnostics and medical examinations, collection and systematization of the data obtained.

The analytical stage of the study was devoted to the processing of the results obtained, statistical analysis of data, formulation of conclusions, and development of practical recommendations. At the same time, special attention was paid to compliance with ethical standards and principles of the study: the voluntary informed consent of the participants was ensured, the confidentiality of the data obtained was guaranteed, the right to refuse to participate at any time in the study was granted, and the psychological safety of all participants was ensured.

To ensure the reliability of the results, double monitoring of filling out research forms was organized, the correctness of diagnostic procedures was checked, regular calibration of medical equipment and monitoring of the quality of data collection were carried out. This comprehensive approach allowed for a comprehensive study of the impact of modern factors on the psychological and psychosomatic health of schoolchildren, to identify key problems and areas for further work to correct them.

Results and Discussion

Psychological and pedagogical indicators

The analysis of the results of psychological and pedagogical diagnostics showed the presence of significant deviations in the psychological state of the examined schoolchildren. The level of anxiety on the Spielberger scale exceeded the standard values in 42% of the surveyed students. Particularly high rates were observed in the age group of 14-16 years, which correlated with an increase in academic workload and the social significance of the period.

The assessment of attention and memory revealed significant concentration impairments in 37% of schoolchildren. The results of the proofreading test showed a decrease in the volume of attention by 25% of the standard indicators, and the speed of information processing according to the Schulte tables was reduced by an average of 18%.

Medical indicators

Analysis of the results of the medical examination revealed a number of significant deviations. Resting blood pressure exceeded the age norm in 28% of the examined patients. After standard physical activity, blood pressure normalization rates were slowed down in 34% of schoolchildren, which indicates violations of adaptive mechanisms.

The indicators of the autonomic nervous system demonstrated a predominance of sympathetic tone in 45% of the examined patients. This was manifested in an increased level of basal pulse and a delayed normalization of indicators after physical exertion.

Laboratory data

The results of a biochemical blood test showed an increase in cortisol levels in 32% of the surveyed schoolchildren, which indicates a chronic state of stress. The level of markers of oxidative stress exceeded the standard values in 26% of the study participants **(Tables 1 and 2)**.

Table 1. The main health indicators of the surveyed schoolchildren

Indicator	The standard value	The average value	Deviations (%)
Blood pressure, mmHg.	110/70	118/75	28%
Pulse rate, beats/min	70-80	85	34%
Cortisol level, nmol/l	138-635	720	32%
Body mass index	18-25	23.4	18%

Table 2. Psychological indicators of the examined schoolchildren

Indicator	The standard value	The average value	Deviations (%)
Anxiety level, points	35-45	48	42%
Amount of attention, symbols	8-10	7.2	37%
Concentration of attention, %	90-100%	82%	25%

Analysis of the impact of digital technologies

The study showed a direct correlation between the time spent using digital devices and health indicators. Schoolchildren who spend more than 4 hours a day watching screens had the following symptoms:

- Increased blood pressure by 12%
- Increased anxiety level by 28%
- Reduction of attention indicators by 20%
- Increased cortisol levels by 35%
- The relationship of social factors

The analysis of social well-being showed that 45% of the surveyed schoolchildren had difficulties in social adaptation. This correlated with indicators of increased anxiety, decreased emotional background, sleep disorders, and increased levels of stress hormones.

The revealed patterns

The study allowed us to establish several significant patterns **(Table 3)**:

- There is a direct relationship between the time of using digital devices and the indicators of vegetative imbalance
- There is a correlation between the level of anxiety and indicators of hormonal stress
- The relationship between social adaptation and psychosomatic indicators has been found.

Table 3. Relationship between health indicators and gadget usage time

Indicator	Less than 2 hours	2-4 hours	More than 4 hours
Blood pressure	92% normal	78% is normal	56% is normal
Anxiety level	65% normal	42% is the norm	28% is the norm
Concentration of attention	85% is the norm	72% is the norm	58% is the norm

The results obtained indicate the presence of significant deviations in the psychological and psychosomatic health of modern schoolchildren. The combination of psychological and physiological disorders is particularly alarming, which requires an integrated approach to solving the identified problems [56, 57].

The conducted research demonstrates the existence of a serious problem in the field of psychological and psychosomatic health of modern schoolchildren [58]. The results obtained suggest the formation of a new phenomenon — digital overload syndrome in school-age children [59, 60]. The fact that 42% of the surveyed students exceeded the standard indicators of anxiety is particularly alarming. This is fully consistent with international studies that have revealed a similar trend of increasing anxiety in children who actively use digital devices [61].

The revealed correlation between psychological and physiological indicators requires special attention. An increase in cortisol levels in 32% of the surveyed schoolchildren is directly related to an increased level of anxiety and prolonged use of digital devices [62, 63]. These data are confirmed by studies of the World Health Organization, indicating a direct link between screen time and stress hormone levels [64].

The established relationship between gadget usage time and health indicators has a clear causal relationship. With an increase in screen time of more than 4 hours per day, there is a significant increase in blood pressure, a significant decrease in attention indicators, an increase in anxiety levels, and a violation of autonomic regulation. These results are consistent with the research of the American Academy of Pediatrics, which notes the negative impact of prolonged use of screens on the physical and mental health of children [65, 66].

The identified difficulties in social adaptation of 45% of the surveyed schoolchildren are closely related to increased anxiety, reduced emotional background, sleep disorders, and increased levels of stress hormones. This relationship is confirmed by the work of Professor Jean Twenge, who has studied the influence of social networks on the psychological state of adolescents [67]. The analysis of the data obtained allows us to identify several key mechanisms for the formation of identified violations. Information overload leads to the depletion of cognitive resources, digital addiction forms sleep and daily routine disorders, social comparison through the media provokes anxiety disorders, and physical inactivity exacerbates vegetative disorders.

The study showed that the identified patterns are universal, regardless of the region of residence. This confirms the global nature of the problem and the need to develop common approaches to its solution. The results obtained are of great practical importance for the development of preventive programs, the creation of recommendations for the rational use of digital technologies, the formation of a strategy for psychological support for schoolchildren, and the improvement of the medical monitoring system.

Further research is needed to study the long-term consequences of the identified violations, develop effective prevention methods, create innovative approaches to correcting the identified deviations, and evaluate the effectiveness of implemented prevention programs.

The conducted research demonstrates the existence of a serious problem in the field of psychological and psychosomatic health of modern schoolchildren. The identified patterns require a comprehensive approach to solving the problem, including the development of programs to reduce screen time, create conditions for increased physical activity, the formation of digital hygiene skills, and the development of psychological resistance to information stress.

The results obtained are consistent with international research and emphasize the need for a global approach to solving the problem of preserving children's psychological health in the era of digitalization. Of particular importance is the development of interdisciplinary prevention programs that combine the efforts of doctors, psychologists, educators, and parents to ensure the full development of the younger generation in digital reality.

Conclusion

The conducted research allowed us to obtain significant results reflecting the state of psychological and psychosomatic health of modern schoolchildren in the context of the digital transformation of society. An analysis of the data obtained showed that 42% of the surveyed students demonstrate an increased level of anxiety, which significantly exceeds the standard indicators. Particularly alarming is the fact that violations of autonomic regulation were detected in 45% of schoolchildren and an increase in cortisol levels in 32% of the study participants, which indicates the presence of chronic stress.

The study revealed a clear relationship between the time spent using digital devices and health indicators. If the screen time exceeds 4 hours a day, there is a significant deterioration in blood pressure, decreased concentration, and increased anxiety levels. Of particular importance are the identified violations of social adaptation, affecting 45% of the surveyed schoolchildren. These disorders are closely related to psychological and physiological indicators, forming a complex syndrome of digital exhaustion.

The results of the study confirm the need to develop a comprehensive system of measures to preserve the psychological health of schoolchildren. It is important to note that the problem is global and requires the consolidation of efforts of specialists of various profiles: doctors, psychologists, educators, and parents.

The practical significance of the work is determined by the possibility of using the results obtained to develop preventive programs, create recommendations for the rational use of digital technologies, form a strategy for psychological support for schoolchildren, and improve the medical monitoring system.

Based on the conducted research, it can be concluded that it is necessary to implement programs to reduce screen time, create conditions for increased physical activity, develop digital hygiene skills, and develop psychological resistance to information stress.

The prospects for further research are related to the study of the long-term consequences of the identified violations and the development of effective methods for their prevention. Of particular relevance is the creation of innovative approaches to correcting identified deviations, taking into account regional peculiarities and the specifics of the modern educational process.

Thus, the problem of preserving the psychological health of children in the era of digitalization requires a systematic approach and interdisciplinary interaction of all stakeholders. Only an integrated approach will ensure the full development of the younger generation in the face of modern challenges.

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